

- MOHR, E. (1936): Osteuropäischer und Wanderigel in Gefangenschaft. Z. Säugetierkunde 11, 242–246.
- NIETHAMMER, J. (1972): Der Igel von Teneriffa. Zool. Beitr., N. F. 18, 307–309.
- PETERS, W. (1877): . . . zeigte einen neuen Igel, *Erinaceus Krugi*, vor. Sitzber. Ges. nat. Freunde, Berlin, 1877, 78–79.
- REUMER, J. W. F. (1980): Evolutive en biogeografie van de kleine zoogdieren van Mallorca (Spanje). Lutra 23, 13–32.
- SAINT GIRONS, M.-C. (1969): Notes sur les mammifères de France. 8. Données sur la morphologie et la répartition de *Erinaceus europaeus* et *Erinaceus algirus*. Mammalia 33, 206–218.
- (1973): Les mammifères de France et du Benelux (fauna marine exceptée). Paris: Doin.
- SANTOS GUERRA, A. (1977): Naturaleza Canaria. pp. 95–138 in (Hernández, P. H. ed.) Natura y cultura de las Islas Canarias. Santa Cruz de Tenerife: Aula Cultura de las Islas Canarias.
- SCHWABE, H. W. (1979): Die Igel von Gran Canaria. Z. Säugetierkunde 44, 132–134.
- SUTER, W. (1982): Ornithologische Beobachtungen auf den Kanarischen Inseln. Manuskript.
- THANNER, R. VON (1913): Wild und Jagd auf den Kanaren. Deutsche Jäger-Zeitung 61 (36), 569–572; (37), 586–589; (38), 600–604; (39), 616–618; (40), 631–633.
- (1915): Bemerkungen und Berichtigungen über die Verbreitung einzelner Vogelarten auf den Kanaren. In Bezug auf die Angaben in den D. A. Bannerman'schen Arbeiten. Orn. Jb. 25, 86–94.
- THOMAS, O. (1915): New African rodents and insectivores, mostly collected by Dr. C. CRISTY for the Congo Museum. Ann. Mag. nat. Hist. 16 (8), 146–152.
- VESMANIS, I. E. (1979): Bemerkungen zur Verbreitung und Taxonomie von *Erinaceus a. algirus* Lereboullet 1842 und *Paraechinus aethiopicus deserti* (Loche 1858) in Tunesien. Afr. small mammal newsl., s. n. 1, 1–14.
- (1981): Über den Wanderigel, *Erinaceus algirus* Lereboullet, 1842, von Djerba (Tunesien) (Mammalia: Insectivora: Erinaceidae). Bonn. zool. Beitr. 31, 207–215.

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## Burrow structure of the Talpid mole *Parascalops breweri* from Oswego County, New York State

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### Abstract

Excavated a complete burrow system of *Parascalops breweri*. Major features included plugged surface mounds, extensive deep and shallow tunnels interconnected by gradual ramps, and a single shallow nest with two entrances. The few accounts in the literature regarding complete excavations of talpid burrows does not indicate clearly the extent of geographical variation in burrow anatomy, or the factors affecting differences.

### Introduction

Secretive in nature, talpid moles have long been the object of much speculation. The European mole has a tradition of lore extending back to King Arthur (SCHEFFER 1949), although information preceding 1900 should be looked at with circumspection (GODFREY and CROWCROFT 1960). The first reference of a mole in America was by SEBA (1734), but it was not until TRUE (1896) that the distribution and taxonomy of American moles became established (JACKSON 1915).

Nonetheless, interest does not always lead to investigation, so that numerous basic areas

of the biology of talpid moles still await study, perhaps none so fundamental as the structure of the burrow system. Moles are intimately associated with the tunnels they construct and spend the vast majority of their lives subterrestrally, so that burrow systems contain clues regarding many aspects of the ecology of the resident mole – it is the means by which the animal relates to the environment: the length of tunnels indicates the extent, area, and range of activities; chambers proffer clues as to food preferences and sociality, breeding, sex, and weight of the occupants; and adaptive behaviours not as yet described may be made known by the unearthing of such structures as bolt-holes, drainage sumps, and spiral ramps. Likewise, vertebrates and invertebrates recovered from within the burrow gives a clearer perspective of biotic interaction.

Due to difficulty in the capture of animals and labor in excavation of tunnels, *Parascalops breweri* is one of many species of fossorial mammals which lack a complete, detailed description of the burrow system. This report details the structure of a completely excavated burrow system of the Hairy-tailed mole and examines the adaptiveness of major features of the burrow structure.

### Materials and methods

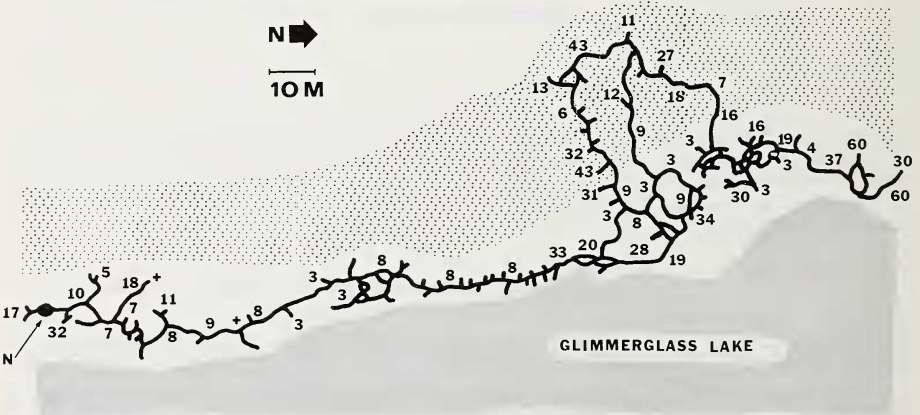
Live-traps (HICKMAN 1979) were set at fresh surface mounds in Oswego County, New York, during July, 1981. A 30 g male Hairy-tailed mole was captured with considerable difficulty, so that JENSEN (1982) live-traps appear preferable for capture of this species.

Excavation was conducted with shovel and trowel. Traps were placed in tunnelways overnight to ensure burrow structure was not altered by intrusion of other moles or rodents. An annotated map was constructed as the excavation proceeded to record direction and depths of tunnels, and the position, shape, size, and contents of chambers. The perimeter of the unearthed burrow was probed with a metal rod to detect tunnels which may have been by-passed because of plugging.

Major features of the burrow system were documented with 35 mm film.

### Results

Several fresh mounds were being constructed in the drier, deeper area of the burrow system while several flatter, older mounds were located in the shallower, heavily anastomosed portion of burrow (see Fig.). Cul-de-sacs were evident in shallow and deep portions of the



A completely excavated burrow system of a 30 g male *Parascalops breweri* from Oswego County, New York, during July, 1981. The nest was located one metre high from water level. An area of mowed grass is indicated by light stipple, crosses mark the position of trees, and N indicates position of the nest

system, perhaps representing laterals from which dirt could be deposited from the main runway to the surface, or short probings for food. All tunnels to the surface were plugged.

Surface ridges marking the position of shallow tunnels were not visible. Tunnel diameter was almost constant at five cms, although the diameter became somewhat constricted in compacted soil. Total burrow length was 550 m, 90 m of which was located in short grassy areas. Anastomosing of burrows was apparent in several areas, both at deep and shallow levels. The major axis of the burrow system was parallel with the lakeshore, although deeper portions of burrow intruded at right angles into the higher areas bordering the lake; deep areas of burrow were not restricted to any particular location. Rather than sharp demarkation of the burrow into deep and shallow areas, gently sloping ramps interconnected changes in elevation; a steep shaft which might have served as a bolt-hole or drainage sump was not found.

A single nest with two entrances was found at a depth of ten cms, measuring 13 cms high, 12 cms wide, and 13 cms long. Dead leaves and grass fit snugly in the chamber. There was no surface structure to indicate the position of the nest. Tunnels dilated a cm or two in several areas, but there was no indication of secondary chambers with stored food, old nesting material, or fecal deposits.

Except for earthworms, the burrow was devoid of other vertebrates or invertebrates.

## Discussion

No diagrams of completely excavated burrow systems of *Parascalops* were found in the literature (HALLETT 1978). Although the Hairy-tailed mole is generally replaced by *Condylura* (the Star-nosed mole) in wet and mucky soils, CONNOR (1960) found five localities where *Parascalops* was taken with specimens of *Condylura*; the portion of tunnel adjacent to the water may have been a portion of appropriated *Condylura* burrow. The following terminology concerning structure of burrows is taken from HICKMAN (1977a).

Fresh mounds were found during July, although mounding is apparently more characteristic just before winter, in October or November, or in spring for female systems (EADIE 1939). All openings to the surface were plugged, even tunnels near the shoreline where the semi-aquatic talpid *Condylura* may leave tunnels unplugged (HICKMAN 1983). There was no evidence of multiple-mounding (several adjacent mounds forming a large conglomerate) which appears more characteristic of rodent-moles than Nearctic insectivore moles.

Tunnels were generally shallow, but without surface ridges which represent surface disruption by narrow, less defined tunnels formed during foraging (EADIE 1939). The majority of tunnels were below eight cms which could well enable use for more than eight years (WRIGHT 1945). An extensive deep portion to the burrow system of *Parascalops* has not been reported; from the position of fresh mounds in the present report, the deeper areas of tunnel system in the grass area were being extended, perhaps in preparation for the freezing temperatures of winter already evident at night. Depth of the tunnel was not much greater than for *Condylura* in the same study area (HICKMAN 1983), so that the benefits of deep tunnels (warmth, higher humidity, security) may follow the law of diminishing returns and eventually be negated by the large energy expenditure needed for distributing soil on the surface. EADIE (1939) reported the deep tunnels of *Parascalops* as being between 25 and 45 cms from the surface. Deep tunnels in the present study were not confined to specific areas; with no bolt-hole present, sanctuary was still available in several areas of the extensive deep burrow system. Stimulus for digging deep tunnels may include cold temperatures (which was likely in the present study); dry conditions which necessitates the seeking of moist, high humid microhabitat; persistent digging at burrow entrances by foxes or other predators; or digging around an edaphic barrier. Main tunnels following prominent surface features such as stone walls (EADIE 1939) may merely represent orientation to moister soil conditions along the wall rather than an attempt to circumvent an obstacle.

The summer nest of the present study was recovered from a depth of ten cms, somewhat shallower than the 25 cm deep nest reported by EADIE (1939); however, both nests were spherical with coarsely shredded leaves. Winter nests are evidently located as deep as 41 cms (EADIE 1939) which indicates that flooding must not be as great a threat in colder weather. Multiple nest entrances appear characteristic for *Parascalops* with EADIE (1939) reporting three entrances for a breeding nest, and two entrances for a winter nest; two entrances were found in the summer nest reported by the present study. A number of entrances/exits to the nest may aid in escape from flooding or predators, among other factors which remain to be suggested. Enlargements of tunnelway which may have been resting areas were found in the present study, but not as large as the eight cm diameter found by EADIE (1939) who also reported two to twelve fecal scats around the perimeter of some tunnel openings, indicating the lack of a specific defecation chamber. Feces were not detected throughout the excavation of the present study, perhaps due to the inconsistent nature of the digested food at that time of year.

The lack of other species in the burrow system may indicate that the burrow system is well patrolled, perhaps more so than for *Condylura* which may forage in water for food and leave tunnel entrances unplugged (HICKMAN 1983). Plugging by *Parascalops* may aid in maintaining temperature and humidity, as well as excluding such predators as bullfrogs (HELLER 1927); nonetheless, EADIE (1939) noted many commensals in burrow systems, commenting that shrews would be dangerous to young moles. The interaction of species within burrow systems is little understood (HICKMAN 1977b), so that the situation between *Condylura* and *Parascalops*, and the relation of talpids to soricids remains an interesting problem.

A more complete knowledge of Nearctic talpid genera is needed before detailed comparison of burrow structures can be undertaken, and adaptive significance of differences fully appreciated. Likewise, a summary of the known structure of talpid burrows ranging across the Palearctic and into the Oriental Region is desirable. By contrasting the burrow systems of the disjunct talpid subfamilies Scalopininae (Nearctic) and Talpininae (Palearctic), it should then be possible to more accurately determine the effect of principle factors moulding structure of the burrow.

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#### Zusammenfassung

*Struktur des Baus vom nordamerikanischen Maulwurf Parascalops breweri im Oswego County, Staat New York*

Ein Gangsystem des nordamerikanischen Maulwurfs *Parascalops breweri* wurde vollständig ausgegraben. Alle Zugänge lagen unter Erdhügeln an der Oberfläche und waren mit Erde zugestopft. Die Gänge verliefen in unterschiedlicher Tiefe und waren durch schräg verlaufende Röhren untereinander verbunden. Nur ein Nest war vorhanden. Es lag 10 cm unter der Oberfläche und hatte zwei Zugänge.

#### References

- CONNOR, P. F. (1966): The mammals of the Tug Hill Plateau, New York. New York State Mus. and Sci. Serv. Bull. 406, 1-82.
- EADIE, W. R. (1939): A contribution to the biology of *Parascalops breweri*. J. Mammalogy 20, 150-173.
- GODFREY, G; CROWCROFT, P. (1960): Life of the mole. London: Museum Press.
- HALLETT, J. G. (1978): *Parascalops breweri*. Mammalian Sp. 98, 1-4.

- HELLER, J. A. (1927): Brewer's mole as food of the bullfrog. *Copeia* **165**, 116.
- HICKMAN, G. C. (1977a): Burrow system structure of *Pappogeomys castanops* (Geomyidae) in Lubbock County, Texas. *American Midland Natural*. **97**, 50–58.
- (1977b): Geomyd interaction in burrow systems. *Texas J. Sci.* **29**, 235–244.
- (1979): A trap and trapping technique for fossorial mammals. *Zoologica Africana* **14**, 9–12.
- (1983): Influence of the semi-aquatic habit in determining burrow structure of the star-nosed mole (*Condylura cristata*). *Canadian J. Zool.* (in press).
- JACKSON, H. H. T. (1915): Review of the American moles. U. S. D. A., North Amer. Fauna **38**, 1–98.
- JENSEN, I. J. (1982): A new live trap for moles. *J. Wildlife Mgmt.* **46**, 249–252.
- SCHEFFER, T. H. (1949): Ecological comparisons of three genera of moles. *Trans. Kansas Acad. Sci.* **52**, 30–37.
- SEBA, A. (1734): *Locupletissimi Rerum Naturalium Thesauri*. Vol. 1, p. 51, Pl. 32.
- TRUE, F. W. (1896): A revision of the American moles. *Proc. U. S. Nat. Mus.* **19**, 1–111.
- WRIGHT, P. L. (1945): *Parascalops* tunnel in use after eight years. *J. Mammalogy* **26**, 438–439.

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## Wie Vampirfledermäuse (*Desmodus rotundus*) ihre Zähne schärfen

Von H. VIERHAUS

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### Abstract

*How Common vampire bats (Desmodus rotundus) sharpen their teeth*

Studied were the dentition and the distal tongue of juvenile and adult *Desmodus rotundus* with a dissection microscope to explain how the upper incisors and canines are sharpened. All crowns are covered by enamel, but the upper teeth lack it on the lingual side and I<sup>1</sup>, C<sup>1</sup> show very thin labial enamel. In the upper jaw thegosis striae have only been confirmed on the lingual surfaces of C<sup>1</sup>, P<sup>1</sup> and M<sup>1</sup> and on the front of C<sup>1</sup>. The lower cheek teeth are abraded on their labial and C<sub>1</sub> on its posterior surface. P<sub>1,2</sub> and M<sub>1</sub> sharpen the posterior edge of C<sup>1</sup> and P<sup>1</sup>, M<sup>1</sup>. C<sub>1</sub> shortens the front of C<sup>1</sup>. I<sup>1</sup> of older specimens has been hollowed out shallowly on its lingual side without signs of typical thegosis. The frontal part of the tongue is covered by special areas of large horny papillae. Therefore the tongue erodes the lingual I<sup>1</sup> and thus sharpens it. Here this is called "tongue-tooth-thegosis". The loss of length in C<sup>1</sup> caused by sharpening is compensated by newly produced cementum on the apex of the root, as described for I<sup>1</sup> elsewhere.

### Einleitung

Zu den besonderen Spezialisierungen der Vampirfledermäuse (Desmodontidae) zählt ihr Gebiß. Die ungewöhnlich gestalteten Schneide- und Eckzähne ermöglichen es diesen, von Wirbeltierblut lebenden Tieren, ihren Opfern schnell und schmerzlos kleine Wunden beizubringen. Während man die rasiermesserscharfen Schneiden dieser Zähne bereits in populärwissenschaftlichen Darstellungen beschrieben findet, ist die Frage, weshalb besonders die oberen Incisiven trotz Gebrauch optimal scharf bleiben, unklar geblieben. Dieses Problem regte zu der vorliegenden Untersuchung an, zumal die bisher hierzu gemachten Vorschläge wenig befriedigend sind. So mißt GREENHALL (1972) den Zahnfleischtaschen, in denen die Spitzen der Incisiven bei geschlossenem Maul ruhen, eine schärfende Wirkung bei, während PHILLIPS und STEINBERG (1976; PHILLIPS et al. 1982) für alle Zähne ein gegenseitiges Schärfen, also Thegose (EVERY und KÜHNE 1971) vorschlagen, dabei aber